

# Summary of the Groundwater-Level Hydrologic Conditions in New Jersey, Water Year 2011

Groundwater is one of the Nation's most important natural resources. It provides about 40 percent of our Nation's public water supply. Nearly 50 percent of New Jersey's drinking water is supplied by more than 300,000 groundwater wells that serve more than 4.3 million people (J.P. Nawyn, U.S. Geological Survey, written commun., 2011). The 2010 Census reported a 4.5-percent increase in population in New Jersey during 2000–10 (2010 Census Data, accessed September 5, 2012, at <http://2010.census.gov/2010census/data/>). As the population increases, so does demand for water. Management of the development and use of the groundwater resource so that the supply can be maintained for an indefinite time without causing unacceptable environmental, economic, or social consequences is critical.

The U.S. Geological Survey (USGS) has operated a groundwater-level monitoring network in New Jersey since 1923. Long-term systematic measurement of water levels, and computerized storage of the data, provide key information needed to evaluate changes in the groundwater resource over time. The water-level data become more valuable as the period of record increases. New Jersey's groundwater network has 94 wells with 50 or more years of record. These data are used to evaluate groundwater recharge and discharge, seasonal fluctuations, effects of long-term climate change, and water-supply development. Water-level data also are used to develop groundwater models and to forecast trends.

This report describes the USGS New Jersey Water Science Center Observation Well Network during water year 2011 (October 1, 2010, through September 30, 2011). Trends in water levels in confined aquifers in southern New Jersey, fractured rock aquifers in northern New Jersey, and unconfined aquifers throughout the State are summarized. Hydrographs of water levels in 12 wells—3 wells open to bedrock, 3 unconfined (water-table) wells, 1 glacial aquifer well, and 5 confined wells—are shown. World Wide Web site addresses for access to the data are included.

## Water-Level Monitoring in 2011

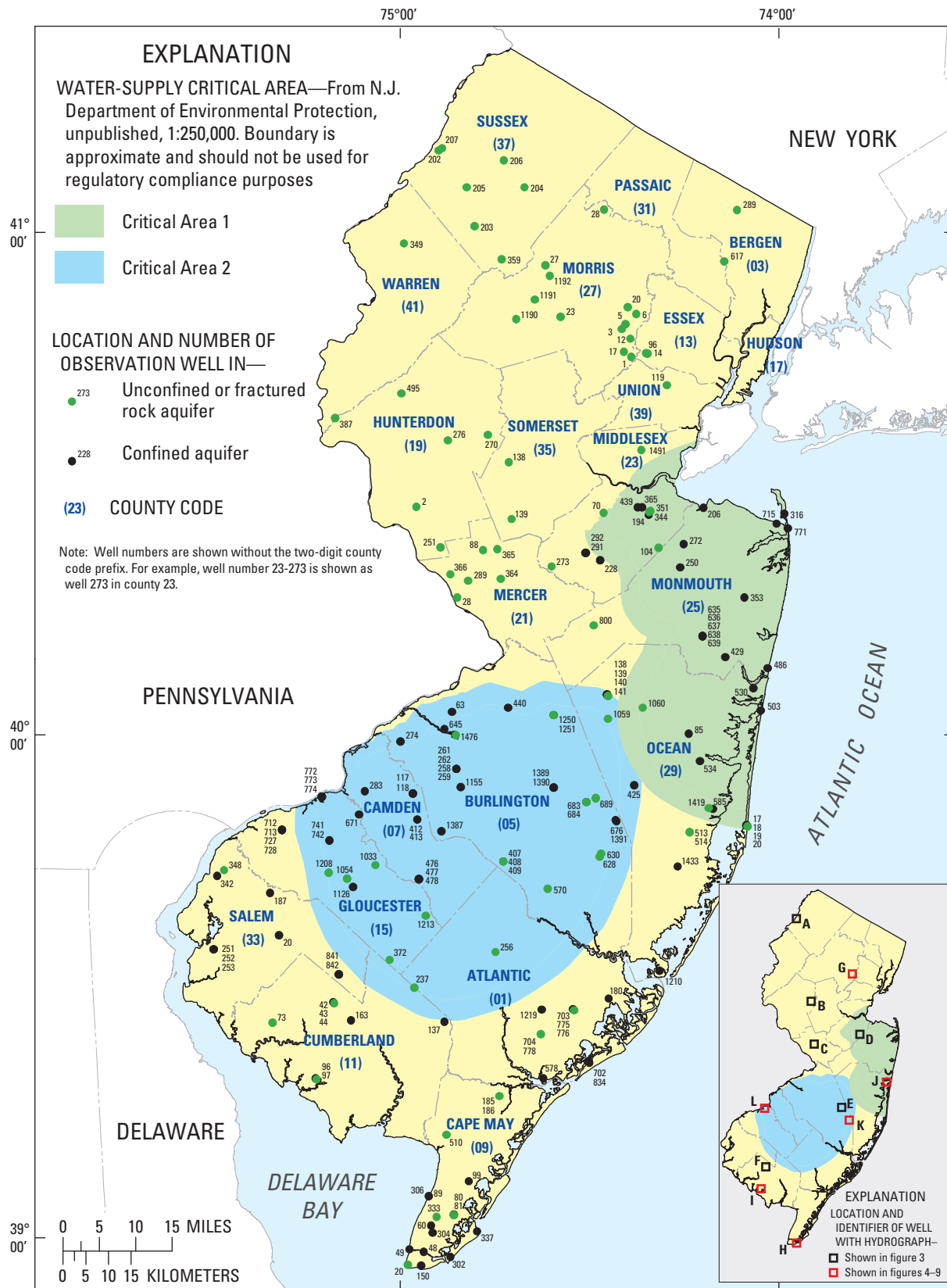
During water year 2011, groundwater levels were measured in 190 network wells; 135 wells were equipped with water-level recorders, and 55 wells were measured manually two to six times per year. Twenty-two wells are equipped with satellite data-collection platforms that provide near real-time data. The locations of the observation wells in New Jersey during the 2011 water year are shown in figure 1. A map with the locations of wells with hydrographs presented in this report is shown in the inset in figure 1. The published data for water year 2011, including site information, tables of water levels, and water-level hydrographs, are available in "Water Resources Data for the United States—Water Year 2011 Annual Water Data Report" at <http://wdr.water.usgs.gov>.

## Water Levels in Unconfined and Fractured-Rock Aquifers

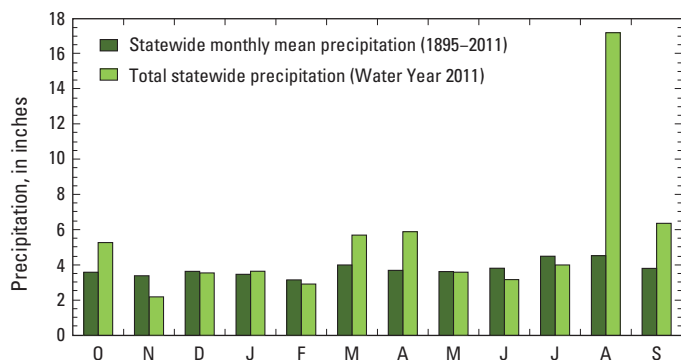
Water levels in wells completed in unconfined and fractured rock aquifers are directly related to the amount of annual precipitation. Average annual precipitation in New Jersey

ranges from about 40 inches along the southeastern coast to 51 inches in the north-central part of the State. The state-wide annual mean precipitation is 45 inches per year, based on precipitation during 1895–2011 (Office of the N.J. State Climatologist, Rutgers University, New Jersey, accessed June 18, 2012, at <http://climate.rutgers.edu/>). Climatically, water year 2011 was a record-setting year. During the 2011 water year, precipitation was nearly 18 inches greater than average (fig. 2). Record-setting precipitation in August (17.16 inches) caused groundwater levels in many unconfined network wells to exceed their previously recorded highest level.

Precipitation in October was nearly 2 inches greater than average, ending the moderate drought conditions that existed during September of the 2010 water year. Precipitation during November through February was near or slightly below the long-term average. In March and April, precipitation was more than 1.5 inches greater than average, causing several wells to exceed their previously recorded highest levels. During May through early August, precipitation levels were near normal; however, temperatures were well above normal, resulting in the third warmest summer on record. Record-setting precipitation in August from Tropical Storm Irene and several other storms resulted in the wettest month ever recorded in New Jersey. Precipitation in August was 12.4 inches greater than average and nearly 5 inches more than the previous record.



**Figure 1.** Location of groundwater-level observation wells in New Jersey.



**Figure 2.** Monthly total precipitation for water year 2011 and monthly mean precipitation in New Jersey during 1895–2011. (Data from Office of the N.J. State Climatologist, Rutgers University, New Jersey)

Tropical Storm Irene, the largest rain storm to hit New Jersey in more than 100 years, deposited an average of 7 inches of rain over the State and more than 11 inches in some areas. The storm caused record flooding and the largest coastal evacuation in the State’s history (Office of the N.J. State Climatologist, Rutgers University, New Jersey, accessed June 18, 2012, at <http://climate.rutgers.edu/stateclim/>). Greater than average precipitation in September caused groundwater levels in many unconfined network wells to exceed their previously recorded highest levels.

The effects of climate on daily mean water levels in six observation wells during water year 2011 can be seen in the hydrographs in figure 3. Daily mean water levels for three wells open to bedrock aquifers [Taylor (37-202), Readington 11 (19-270), and Cranston Farms 15 (21-364) observation wells] and three wells open to unconfined aquifers [Morrell 1 (23-104), Lebanon State Forest 23-D (5-689), and Vocational School 2 (11-42) observation wells] are shown in relation to long-term monthly extremes, monthly medians, and percentile classes. In the wells that tap bedrock aquifers (37-202, 19-270, and 21-364), the highest groundwater levels of the year occurred during September, when wells 37-202 and 19-270 exceeded their previously recorded highest levels. Groundwater levels in wells 19-270 and 21-364 declined steeply during May to mid-August because of the hot and dry conditions. Water levels in all three bedrock wells declined to near their long-term monthly medians. In wells open to the unconfined Kirkwood-Cohansey aquifer (5-689 and 11-42) in the Coastal Plain of New Jersey, water levels rose as a result of the greater than average precipitation during March, April, August, and September but declined from May through July to near the 25th percentile class for July. Water levels in well 23-104, a shallow well in the outcrop area of the Englishtown aquifer system, briefly exceeded the previously recorded monthly high in February through April, declined in May through mid-August, and rose in mid-August through September, exceeding the previously recorded highest level in August.

Water levels in many USGS observation wells that tap stratified drift deposits in eastern Morris and western Essex

Counties were near their highest levels in the last 30 years (27-1, 27-4, 27-5, 27-6, 27-12, 27-17, 27-20, 13-13, 13-95, and 13-96). The water level in the Briarwood School well (27-12) rose nearly 32 feet from December 2002 through September 2011 (fig. 4). This rise was due, in part, to a reduction in the use of groundwater and increased use of surface water in this area in recent years.

## Water Levels in Confined Aquifers

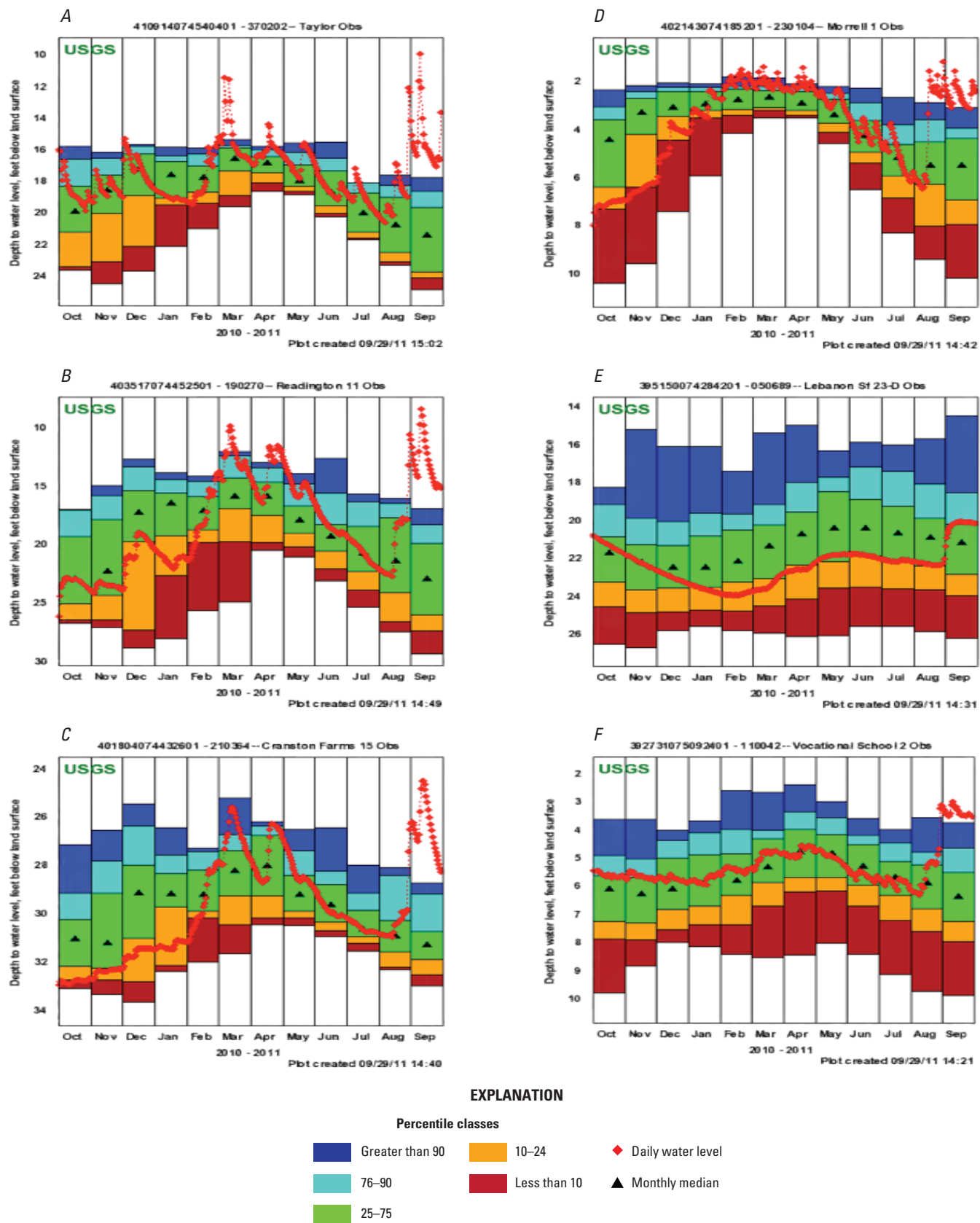
Water levels in the confined aquifers in the Coastal Plain of New Jersey fluctuate seasonally in response to increased groundwater withdrawals during the summer when water levels decline and decreased withdrawals during the winter when water levels rise. However, groundwater levels also show the effects of changes in withdrawal patterns. In general, water-level changes in these aquifers are the result of changes in withdrawals rather than climatic variations.

Seasonal fluctuations in water levels in the confined Cohansey aquifer in Cape May County caused by withdrawal patterns ranged from 4 to 17 feet in USGS observation wells. Groundwater levels in this aquifer have been stable in recent years (2001–11), rising slightly in three wells—a maximum of 3 feet—and declining 1 foot in one well over the period. No well in the Cohansey aquifer exceeded the previously recorded high or low during the 2011 water year.

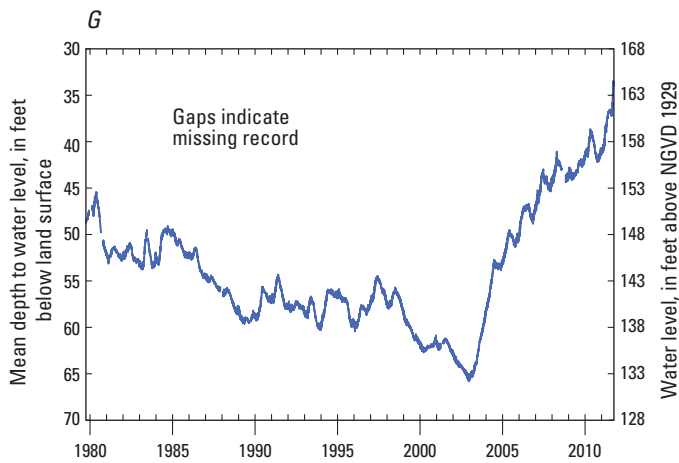
Increased withdrawals have adversely affected water levels in the Atlantic City 800-foot sand in Atlantic, Cape May, and southern Ocean Counties. Water levels declined an average of 4.1 feet in all 10 USGS observation wells screened in the Atlantic City 800-foot sand in the last 3 water years (2009–11) and an average of 6.1 feet during water years 2002–11 in all 7 wells with 10 or more years of record. Water levels in well 9-302 (fig. 5) and five other wells open to this aquifer (1-704 9-185, 9-306, 9-337, and 29-1433) exceeded their previously recorded lows during the 2011 water year.

Increased withdrawals from the Piney Point aquifer have affected groundwater levels in USGS observation wells. Water levels in two wells open to the Piney Point aquifer in Cumberland County—wells 11-96 (fig. 6) and 11-163—declined 30 and 45 feet, respectively, from 2001 through 2011. Water levels in a third well, 11-44, have declined 73 feet since June 2004. In Atlantic County and southern Ocean County, water levels continued a long-term decline in wells 1-834, 1-1219, and 29-1210. Water levels in wells 5-407, 5-676, 29-18, 29-425, and 29-585 in the Piney Point aquifer in northern Ocean and Burlington Counties have been relatively stable over the past 10 years. Water levels in wells 1-1219, 11-44, 11-96, and 11-163 exceeded their previously recorded low during the 2011 water year.

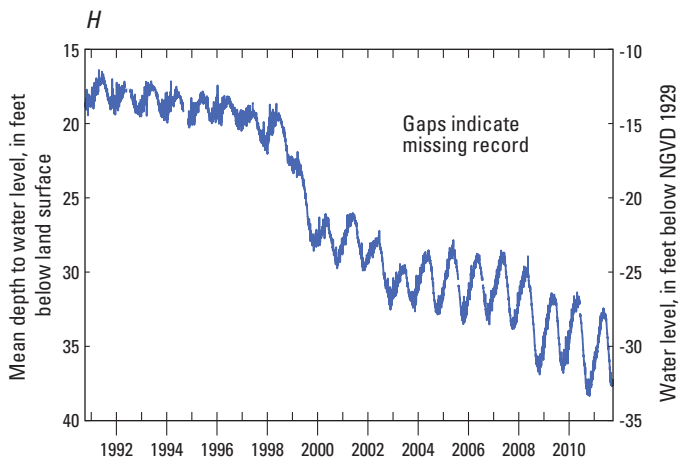
Water levels in observation wells that tap the Wenonah-Mount Laurel aquifer in Burlington, Camden, Gloucester, and Salem Counties (5-1155, 5-1387, 7-478 15-1126, and 33-20) rose slightly during the 2009–11 water years. In Monmouth and northern Ocean Counties, groundwater levels in



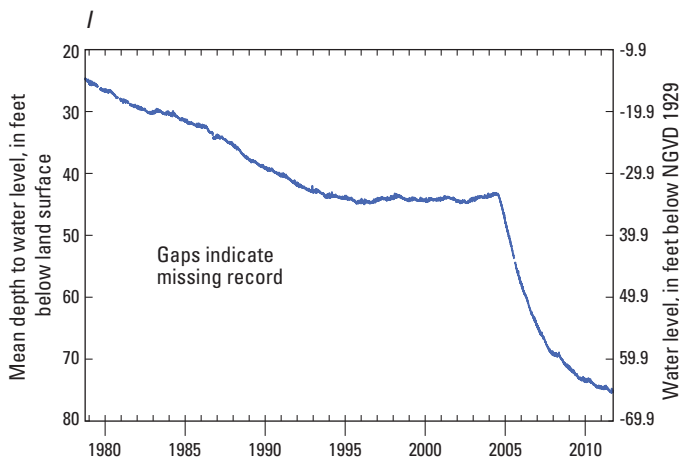
**Figure 3.** Groundwater levels in three bedrock wells in northern New Jersey (A–C) and three unconfined aquifer wells (D–F) in the New Jersey Coastal Plain, 2011.



**Figure 4.** Long-term water levels in well 27-12 screened in the glacial aquifer (stratified drift), New Jersey, 1979–2011. (*G* in figure 1)



**Figure 5.** Long-term water levels in well 9-302 screened in the Atlantic City 800-foot sand, New Jersey, 1991–2011. (*H* in figure 1)

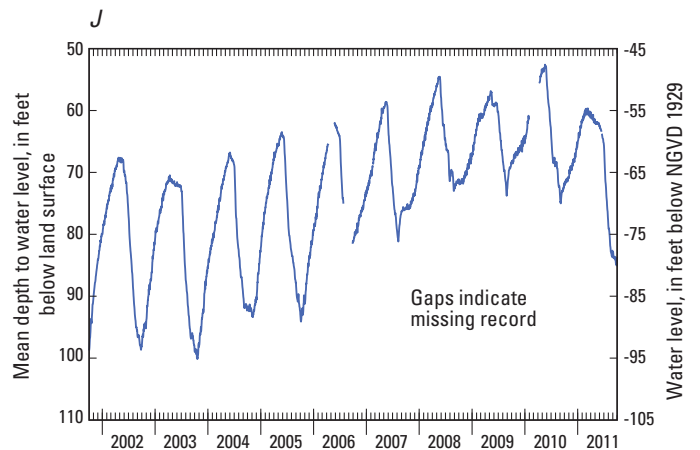


**Figure 6.** Long-term water levels in well 11-96 screened in the Piney Point aquifer, New Jersey, 1978–2011. (*I* in figure 1)

observation wells have been stable during this period. Groundwater levels in well 25-800 exceeded its previously recorded high.

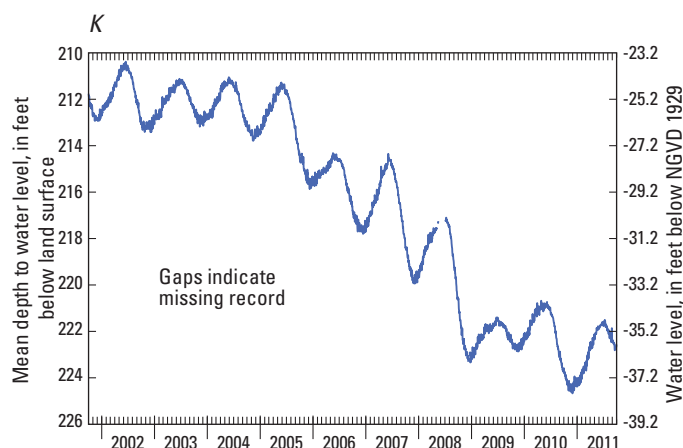
Water levels in observation wells that tap the English-town aquifer system in eastern Ocean County [29-503 (fig. 7), 29-530, and 29-534] rose 10 to 16 feet during the 2002–11 water years. In Monmouth, western Ocean, and Burlington Counties, groundwater levels in observation wells were relatively stable during this period. Groundwater levels in well 23-104 exceeded its previously recorded high, and levels in well 5-1390 exceeded its previously recorded low.

The response of groundwater levels to withdrawals in the Potomac-Raritan-Magothy aquifer system has been mixed. Withdrawals from the Upper Potomac-Raritan-Magothy aquifer caused slight declines in water levels in several wells in central Burlington, Monmouth, and Middlesex Counties during water years 2009–11 [5-1389, 5-1391 (fig. 8), 25-639, 25-316, and 23-292]. Water levels in all USGS observation wells that tap the Upper Potomac-Raritan-Magothy aquifer system in western Burlington, Camden, Gloucester, and Salem Counties, however, rose gradually over the past few years [5-258 (5 feet), 7-477 (7 feet), 15-741 (4 feet), and 33-253 (2 feet)]. In general, recovery continues throughout much of this area. Water levels in all USGS observation wells that tap the Middle and Lower Potomac-Raritan-Magothy aquifer rose gradually over the 2002–11 water years. Groundwater levels in several wells exceeded their previously recorded highs, including 15-671, 15-742, 15-772 (fig. 9), and 33-841. Groundwater levels in two wells in the Upper Potomac-Raritan-Magothy aquifer, 5-1389 and 5-1391, exceeded their previously recorded lows.

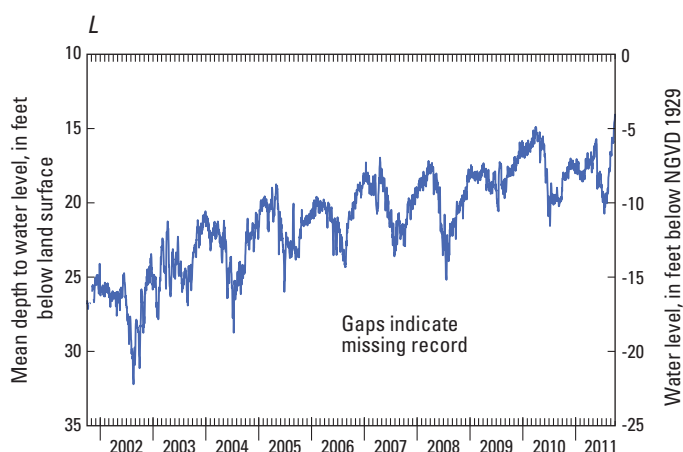


**Figure 7.** Long-term water levels in well 29-503 screened in the Englishtown aquifer system, New Jersey, 2002–11. (*J* in figure 1)





**Figure 8.** Long-term water levels in well 5-1391 screened in the Upper Potomac-Raritan-Magothy aquifer, New Jersey, 2002–11. (K in figure 1)



**Figure 9.** Long-term water levels in well 15-772 screened in the Lower Potomac-Raritan-Magothy aquifer, New Jersey, 2002–11. (L in figure 1)

## Availability of Data

The water-level data in the 2011 New Jersey Annual Data Report can be accessed online at “2011 Annual Water Data Report” (<http://wdr.water.usgs.gov/wy2011/search.jsp>). A map interface is available at this site with links to hydrographs and tables of the water levels recorded or measured during water year 2011.

The Active Water-Level Network web site shows data and statistics (if sufficient data are available to produce statistics) for all wells measured in the current year by New Jersey Water Science Center personnel; it can be accessed at “Active New Jersey Groundwater Sites” (<http://groundwaterwatch.usgs.gov/StateMaps/NJ.html>). Data from the 22 wells in

New Jersey equipped with real-time capability can be accessed at “Real-time Groundwater Network” (<http://groundwaterwatch.usgs.gov/>).

Hydrologic data are recognized as the cornerstone of hydrologic science. Accurate measurements of groundwater levels provide important indicators of the status of our groundwater resources. By collecting and storing data pertaining to the quantity, quality, and use of our Nation’s groundwater and providing timely access via the internet, the USGS helps water resource-managers develop, regulate, and monitor the resource to ensure its continued availability for future generations.

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